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Surface plates —

Part 1: Cast iron

Marbres de traçage et de contrôle —
Partie 1: Marbres en fonte



Reference number
ISO 8512-1:1990(E)

Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8512-1 was prepared by Technical Committee ISO/TC 3, *Limits and fits*.

ISO 8512 consists of the following parts, under the general title *Surface plates*:

- *Part 1: Cast iron*
- *Part 2: Granite*

Annexes A, B, C and D of this part of ISO 8512 are for information only.

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Introduction

Surface plates, for many practical purposes, serve the user as a plane or datum surface.

Surface plates are made usually of cast iron or granite; other materials may be used provided that they comply with the requirements for quality and accuracy specified in this International Standard.

For convenience of presentation ISO 8512 comprises two parts, each complete in itself, dealing with cast iron and granite surface plates respectively.

The choice between cast iron and granite surface plates depends on the conditions of use; some general information about care and use, testing, and moderation in loading of plates is given in annex A, annex B and annex C, respectively.

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Surface plates —

Part 1: Cast iron

1 Scope

This part of ISO 8512 specifies requirements for rectangular or square cast iron surface plates ranging from 160 mm × 100 mm to 2 500 mm × 1 600 mm, as preferred sizes, in four grades of accuracy 0, 1, 2 and 3.

This part of ISO 8512 applies to new cast iron surface plates, cast iron surface plates in use, and those reconditioned according to their grade.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 8512. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8512 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 185:1988, *Grey cast iron — Classification*.

3 Definition

For the purposes of this part of ISO 8512, the following definition applies.

deviation from flatness of the working surface: The minimum distance separating two parallel planes

between which the working surface can just be contained.

4 Nomenclature

For the purposes of this part of ISO 8512, the nomenclature shown in figure 1 applies.

5 Material

Good quality, close-grained, plain cast iron or alloy cast iron at least equal to grade 250 of ISO 185 shall be used; the material shall be sound and free from blow holes and porous patches. Minor defects in working surfaces of grades 2 and 3 only may be repaired by plugging with material of composition similar to that of the plate.

6 Stress relief

After being cast and rough machined, all plates of grades 0 and 1 and of size up to and including 400 mm × 250 mm shall be given a suitable treatment to relieve internal stresses before being finished. It is strongly recommended that larger plates of all grades be stress-relieved by similar means; however, where facilities for this purpose are not available, such plates may be stabilized by natural ageing by agreement with the purchaser.

The manufacturer shall, on request, supply the purchaser with a statement of the stress-relieving process which the plate has received.

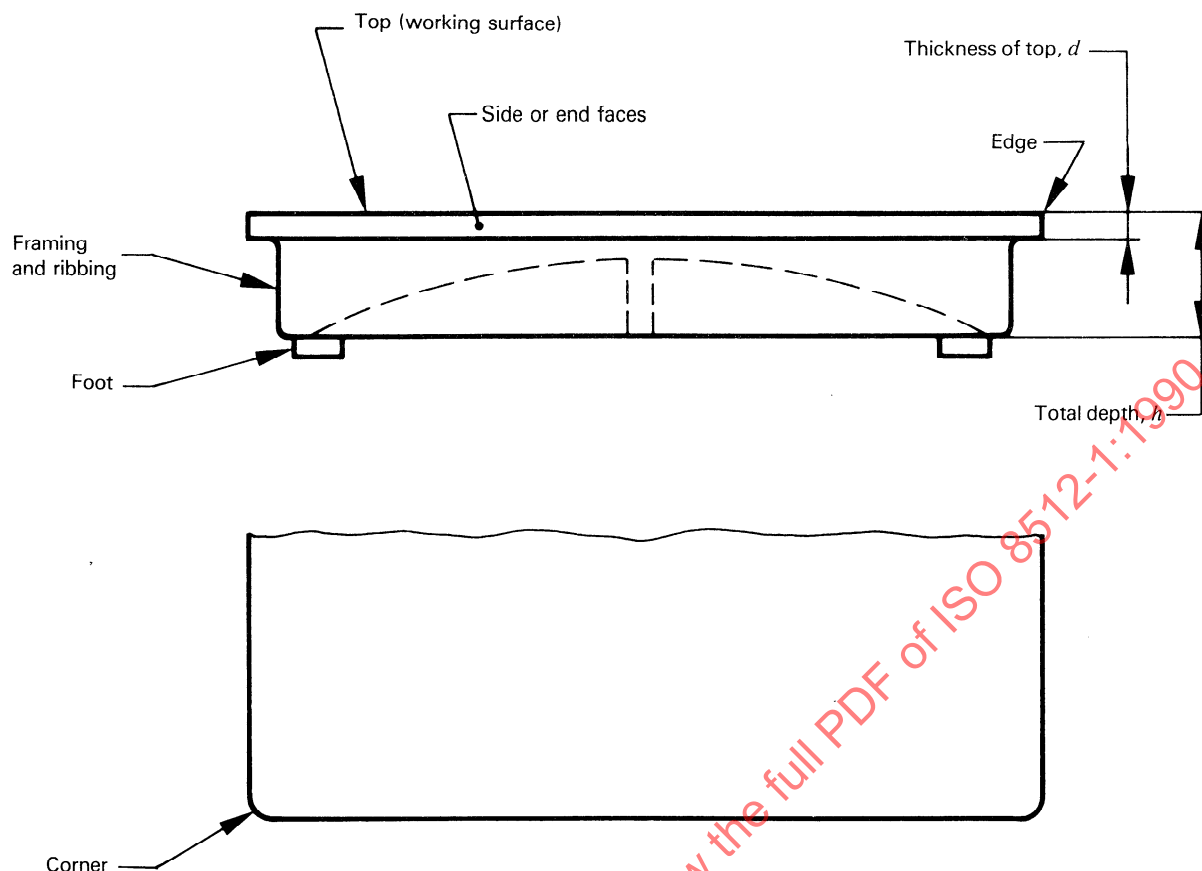


Figure 1 — Nomenclature

7 Preferred sizes

The preferred sizes for cast iron plates are given in table 1. If plates of other sizes are required, the requirements of this part of ISO 8512 shall nevertheless apply.

The lengths of faces of plates shall be within $\pm 5\%$ of the nominal size.

NOTES

1 There may be a transition period, however, until existing stocks of castings are exhausted and before patterns for the sizes specified in this part of ISO 8512 replace those currently in use. During this period national standards may be unable to make the $\pm 5\%$ tolerance mandatory.

2 It will be seen that the nominal lengths of faces, with one exception, are taken from the R5 series of preferred numbers; one plate, size 2000 mm $\times$ 1000 mm, is included because it is an established and widely used size, although 2000 is not an R5 preferred number.

8 Rigidity

Cast iron surface plates shall be made with adequate ribbing and the total depth [i.e. the combined thickness of the top (working surface) and the depth of the framing] shall be such that when a concentrated load is applied about the centre of the plate, the loaded area shall not deflect below the remaining area of the plate by more than $1 \mu\text{m}/200 \text{ N}$. The limiting value for deflection applies to surface plates of size 400 mm $\times$ 250 mm and larger.

NOTE 3 A test method is given in annex B.

9 Finish of the working surface

The top (working surface) of grades 0 and 1 plates shall be finished by scraping or other process which results in a surface similar to that obtained by scraping. Grades 2 and 3 plates may be finished by the same processes or by machining.

The bearing area shall be not less than 20 % for grade 0, 15 % for grade 1 and 10 % for grades 2 and 3. High spots shall be uniformly distributed and the percentage of bearing area should not be so high as to cause wringing.

NOTE 4 A method of assessing the bearing area is given in annex B.

10 General features

10.1 Supporting feet of surface plates

All surface plates shall be supported on three feet. Plates larger than size 1 000 mm × 630 mm shall have safety feet. Feet shall be positioned within the boundary of the working surface to minimize deflection.

NOTE 5 The setting of adjustable feet may affect the deviation from flatness of the working surface; specific instructions for adjusting the feet are given in footnote 3 to table 1.

The feet shall be smoothly machined, but machining of the supporting feet into a plane parallel to the working surface is optional.

10.2 Projection of top

The top of each plate of size 400 mm × 250 mm and larger shall extend at least 25 mm beyond the framing on all sides; the underside of this projecting surface shall be reasonably flat for accommodating clamps.

It is not mandatory for plates smaller than size 400 mm × 250 mm to extend beyond the framing, but if they do, the top shall extend at least 20 mm and shall be reasonably flat on the underside.

10.3 Edges

The side and end faces of the plate shall be machined; if the purchaser requires the side and end faces to be finished straight, mutually parallel and square, the tolerances shall be specified in the purchasing order.

All edges and corners shall be rounded with a radius of at least 2 mm. Alternatively, the edges and corners may be chamfered at an angle of approximately 45° using the value given above.

10.4 Handling

The plates shall be provided with means for convenient handling.

10.5 Clamping methods (i.e. tapped holes or slots)

The use of tapped holes in the plate for clamping purposes can cause distortion of the working surface if high clamping pressures are applied. The

Table 1 — Tolerances on deviation from flatness overall

Dimensions in millimetres; tolerances in micrometres

Size of plate	Diagonal length (approx.)	Border zone	Tolerance on deviation from flatness overall ^{1) 2)} for plates of grade			
			0	1	2	3
Rectangular						
160 × 100	188	2	3	6	12	25
250 × 160	296	3	3,5	7	14	27
400 × 250	471	5	4	8	16	32
630 × 400	745	8	5	10	20	39
1 000 × 630	1 180	13	6	12	24	49
1 600 × 1 000 ³⁾	1 880	20	8	16	33	66
2 000 × 1 000 ³⁾	2 236	20	9,5	19	38	75
2 500 × 1 600 ³⁾	2 960	20	11,5	23	46	92
Square						
250 × 250	354	5	3,5	7	15	30
400 × 400	566	8	4,5	9	17	34
630 × 630	891	13	5	10	21	42
1 000 × 1 000 ³⁾	1 414	20	7	14	28	56

1) The bases of the tolerances specified are given in annex D.

2) Tolerances on deviation from flatness overall are expressed to the nearest

0,5 µm for plates of grade 0,

1 µm for plates of grades 1, 2 and 3.

3) These plates are supplied with more than three feet. Typically, after the plate has been carefully levelled by the three primary levelling screws, then the remaining supports may be adjusted either so that they are just in contact without disturbing the setting of the level or to give a minimum deviation from flatness. The tolerance applies after the supports have been adjusted and set in the manner agreed between the purchaser and manufacturer. These plates should be checked regularly to ensure that the setting has not been disturbed.

onus is on the purchaser whether or not tapped holes or slots in plates are to be provided.

11 Accuracy — Flatness tolerances

11.1 General

Two flatness tolerances are applied, one for the working surface overall and one for any local area of 250 mm × 250 mm of the working surface.

A border zone, the width of which shall not exceed 2 % of the shorter side with a maximum of 20 mm, may be excluded from these requirements for accuracy provided that no point on the border zone projects higher than the remainder of the working surface of the plate.

11.2 Flatness of the working surface overall

The flatness deviation of the working surface overall shall not exceed the appropriate tolerance for size and grade of accuracy specified in table 1.

NOTE 6 Test methods are given in annex B.

In the case of sizes which differ from those in the preferred range, the tolerance on deviation from flatness overall should be calculated in accordance with annex D.

11.3 Flatness of any local area of the working surface

The flatness deviation of any local area of 250 mm × 250 mm of the working surface shall not exceed

- a) 3,5 µm for plates of grade 0;
- b) 7 µm for plates of grade 1;
- c) 15 µm for plates of grade 2;
- d) 30 µm for plates of grade 3.

NOTES

7 The tolerances specified above are the same as those applied to the flatness overall of a 250 mm × 250 mm surface plate (see table 1).

8 Plates with a diagonal length smaller than 354 mm do not permit a 250 mm × 250 mm search area and in these cases the test on flatness overall serves to reveal local deviations from flatness.

12 Marking

Each plate shall be legibly and permanently marked or shall bear a designation plate attached to one face; the following information, in characters not less than 3 mm high, shall be included:

- a) the manufacturer's name or trade-mark;
- b) the number of this part of ISO 8512;
- c) the grade of accuracy.

DESIGNATION EXAMPLE

X & Co. ISO 8512-1 Grade 0

Annex A (informative)

Use and care of cast iron surface plates

A.1 A surface plate should be located in a circulated atmosphere under constant temperature control. Accordingly it should be protected from direct sunlight or draughts; in particular, it is important that these should not cause a vertical gradient of temperature such that the working surface and underside of the plate are at different temperatures. For example, if there is a persistent difference of 1 °C between the working surface and underside of a plate 1000 mm long and 250 mm thick, there can be a distortion of about 5 µm: this is 80 % of the total manufacturing tolerance in a 1000 mm × 630 mm plate of grade 0.

NOTE 9 The cellular form of the framing and ribbing, the relatively thin top of the plate and its thermal conductivity assist in acclimatizing cast iron surface plates readily when the ambient temperature returns to uniformity.

A.2 The plate should be supported firmly and levelled. Stands should be located on a stable foundation.

A.3 Attention is drawn to the procedure for setting surface plates (see footnote 3 to table 1).

A.4 Clause 8 and clause B.3 refer to the rigidity of a surface plate; care should be taken not to overload a plate. Suggestions regarding reasonable loading are given in annex C.

A.5 Point contact to scraped or machined surface plates is not permissible because of local irregularities of the surface.

Contact should be made through either an intermediate precision gauge block, preferably not more than 10 mm high, or a similar precision distance piece.

A.6 Use should be made of the available area of the plate and should not always be concentrated in one area.

A.7 The surface plate is a datum and should be protected against damage. The top should be frequently wiped clean from dust and other particles. When measurements are being made, a wiping cloth should be spread on the plate for small tools and gauge blocks.

A.8 A common sign of damage is burrs on the surface. The excess metal may be stoned away by local treatment confined to the burr; this operation should be followed by thorough cleaning from abrasive dust.

Rusting is a sign of neglect and misuse; it can be reduced by frequently wiping the top when in use and on occasions by gently rubbing with another plate using a paste of a little "jewellers' rouge" and paraffin as a lubricant.

A.9 When the plate is not in use the top should always be kept covered. If the plate is not required for some days the surface should be coated with a corrosion-preventive such as vaseline.

A.10 Plates wear as a result of use. The user can detect evidence of wear by rubbing the plate with a superior grade plate and studying the rubbed appearance and/or by checking straightness along lines on the plate and/or by using the datum gauge (see the tests described in annex B).

A.11 Users are advised to take advantage of the specialist services of surface plate manufacturers to have plates reconditioned.

Annex B (informative)

Testing of surface plates

NOTE 10 Various test methods are available and details can be found in technical books; selected typical methods are outlined below.

B.1 Deviations from flatness overall

B.1.1 Surface plates with a machined finish may be tested by comparison with a superior grade plate of larger area.

A robust comparator stand is moved on a region of the working surface of the larger plate selected for minimum deviation from flatness. The measuring head having light operating force is carried in a right extension arm from the stand and is in contact with a gauge block or similar distance piece (see clause A.5) which is moved on the plate under test. This method is suitable for small plates.

B.1.2 Larger surface plates with a machined finish may be tested by measuring deviation from straightness along various lines parallel to the faces, and along the diagonals, by comparison with a reference straight edge. The results are then integrated into deviation from flatness by relating the results at the centrepoint of the plate where the two diagonal surveys cross and at other points where lines of test intersect.

B.1.3 Plates may also be tested by checking straightness along various lines on the plate using a block which, as it is moved along a line step by step, tilts according to the deviations from straightness.

The tilts may be measured by means of a spirit level or an electronic level where the block is of an appropriate size for testing the plate in some detail, but also large enough to carry the instrument. The plate should itself be solid enough not to be deflected by the load of the level and block, and the foundation should be stable enough to remain un-tilted by the movements of observer and apparatus.

Alternatively, an optical instrument, namely an autocollimator, is suitable for observing the tilts of an exploring block on any of the surface plates complying with this part of ISO 8512. Plates of

grade 0 require a sensitivity of reading of 1 second of arc; less sensitive instruments may be used more conveniently on coarser grades of plate.

B.2 Deviations from flatness locally

B.2.1 Inspection of a new plate for deviation from flatness locally is recommended; moreover it is also particularly necessary if wear is suspected and/or if the working surface is not a consistent datum.

B.2.2 Although the methods described in clause B.1 may use 50 or more located positions of measurement for the contour map of a plate, there nevertheless remain local positions, and on large plates, local areas, which may not be covered in the overall survey. Accordingly, an exploration of flatness of local areas is necessary, and, for this purpose, the methods described in clause B.1 can be applied to many more positions of measurement. However, this approach is cumbersome. Alternatively, since local deviations from flatness affect the surface plate as a datum, they may be traced by a datum gauge. A typical example of a datum gauge is shown in figure B.1: it is a freely moved, scribing block base with three fixed contacts representing a datum; an extension carries a sensitive indicator in contact with a pad in spring contact with the surface plate. It is recommended that insulated handles be fitted to isolate the warmth of the hand from the device and to facilitate its use.

B.2.3 The following procedure is recommended.

- a) First visually inspect the working surface to note any irregularities of appearance. The results of measurement of deviation of flatness overall should be studied to identify where abrupt or large changes in contour occur. A rapid sweep of the whole plate can be made with the datum gauge to identify the areas of greatest variation.
- b) Check areas where the datum gauge shows variations of reading exceeding the tolerance on local deviation using the methods described in clause B.1.

B.3 Rigidity test

B.3.1 A surface plate being subjected to a rigidity test is illustrated in figure B.2a): the apparatus used comprises essentially

- a beam comparator ④ incorporating a sensitive indicator ⑤;
- a central mass support ⑥ independent of the beam;
- the requisite number of masses ③ [only one mass is shown in figure B.2a)].

An end-on view of the apparatus, with the central support ⑥ unloaded, is illustrated in figure B.2b); the plate is standing on its three feet.

The beam comparator is a rigid structure which is supported on two feet ④, each of which can be positioned along the length of the beam. A third foot ⑥ [see figure B.2b)], which is positioned centrally along the beam and offset, is provided to keep the beam stable. A sensitive indicator ⑤, with its contact tip pressed against the surface plate, is rigidly clamped to the centre of the beam.

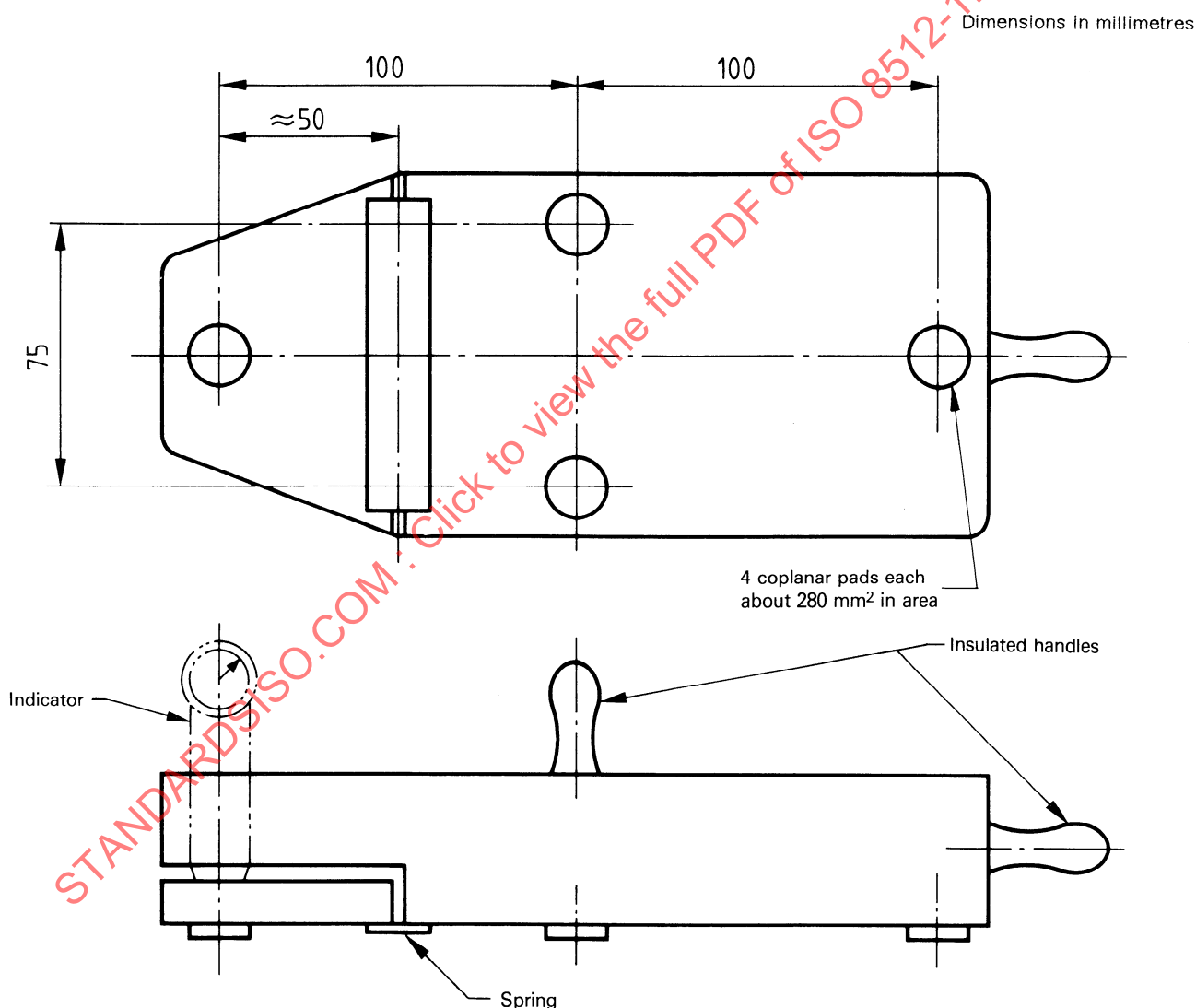
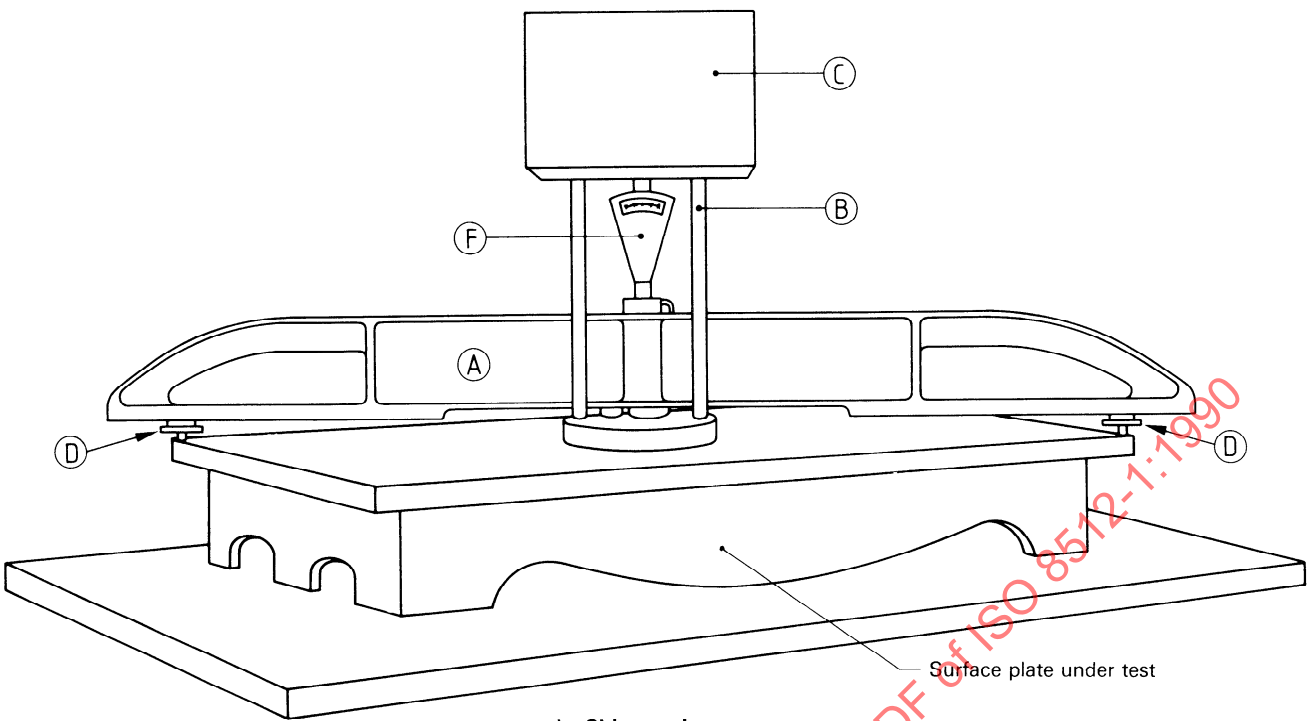
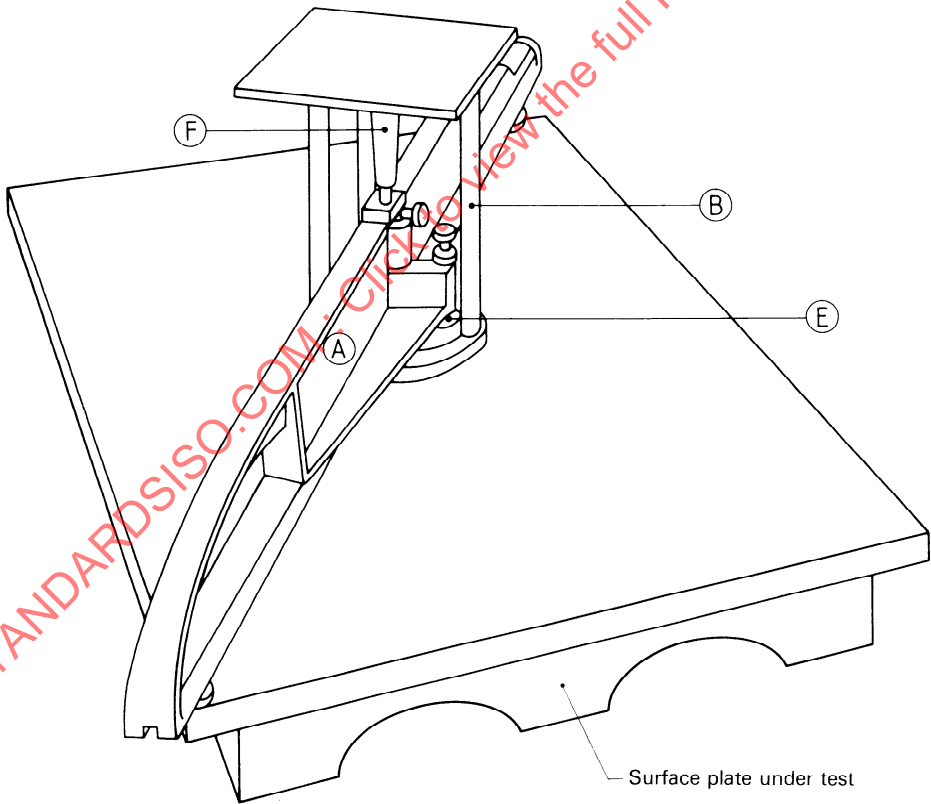


Figure B.1 — Example of typical datum gauge



a) Side-on view



b) End-on view

Key

(A) Beam comparator	(C) Mass(es) (for application of load)	(E) Third foot (offset)
(B) Central mass support	(D) Supporting feet (two)	(F) Sensitive indicator

Figure B.2 — Test apparatus for rigidity test